

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 5, May 2018

Experimental Investigation on Replacement Concrete Beam Reinforced with Glass Fiber Rebars

M.Rajakumar¹, P.Anitha²

P.G. Student, Department of Civil Engineering, Sethu Institute of Technology, Pulloor, Kariapati, India¹

Assistant Professor, Department of Civil Engineering, Sethu Institute of Technology, Pulloor,
Kariapati, India²

ABSTRACT: Reinforced Cement Concrete (RCC) structures are usually reinforced with steel bars which are subjected to corrosion at critical temperatures and atmospheric conditions. Also the cost of steel reinforcement plays a significant role in any RCC construction. The rising prices of steel and their unavailability throughout the year have brought the contractors and engineers into a great trouble. The RCC structures can also be reinforced with other materials such as fibres specifically Glass Fibre Reinforced Polymer (GFRP). This paper deals with the study of RCC beams when reinforced with the Glass Fibre Reinforced Polymer (GFRP) as a replacement of steel reinforcement and studying the behaviour of beam under flexure. The GFRP as an internal reinforcement has proved to be of great interest not only in India but worldwide.

KEYWORDS: Fine aggregate, Coarse aggregate, GFRP..

I. INTRODUCTION

Reinforced concrete is a common building material for construction of facilities and structures. While concrete has high compressive strength, it has limited tensile strength. To overcome these tensile limitations, reinforcing bars (rebar) are used in the tension side of concrete structures. Steel rebar has historically been used as an effective and cost efficient concrete reinforcement. When not subjected to chloride ion attack, steel reinforcement can last for decades without exhibiting any visible signs of deterioration. However, steel rebar is very susceptible to oxidation (rust) when exposed to chlorides. Examples of such exposure include coastal areas, salt contaminated aggregates used in the concrete mixture and sites where aggressive chemicals and ground conditions exist. In cold climates, treating snow with salt is another cause of accelerated deterioration of concrete bridge decks. When corrosion of steel rebar occurs, the resulting corrosion products have a volume 2 to 5 times larger than the original steel reinforcement. As the concrete cannot physically sustain the high internal tensile stresses developed from this volume increase, it eventually may crack and spall causing further deterioration of the steel. The combination of ongoing deterioration and loss of reinforcement properties ultimately requires potentially significant and high cost repairs and possibly the endangerment of the structure itself. The advantageous properties of fiber reinforced polymer (FRP) such as high strength-to-weight ratio, and corrosion and fatigue resistance create an interest in engineers.

II. MATERIALS AND METHODS

Cement:

Cement is a binder that sets and hardens and can bind other materials together. Ordinary Portland Cement (OPC) 53 grade is used.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 5, May 2018

Fine aggregate:

The specific gravity of fine aggregate was 2.67. The sand particles should also pack to give minimum void ratio, higher voids content leads to requirement of more mixing water. In the present study the sand conforms to zone II as per the Indian standards.

Coarse aggregate:

Angular shape aggregate which passes through 20 mm sieve and retain on 10mm are used as coarse aggregate in this project work. The specific gravity of coarse aggregate was 2.77. Coarse aggregate is the most grounded and scarcest penetrable part of concrete. It is all around that pounded stone aggregate lead to higher qualities than adjusted ones.

GLASS FIBER REINFORCED POLYMER:

GFRP bars are manufactured by a pultrusion process with 75% of glass fiber composition. These bars are available with outer diameter from 4 to 20 mm with evenly distributed spiral relief of any construction length based on requirement as shown in Fig. 2. Since, the fixture has more fiber content it has good physical, chemical and strength characteristics which is compared with steel bar. Where, GFRP bar is 4 times lighter than steel reinforcement with equal strength characteristics, which significantly reduces transportation costs for shipping, loading and unloading, as well as operating expenses at the construction site.

Mix design:

The mix design of M20 grade concrete is calculated using IS 456-2000 and IS 10262-2009. The material required as per design are given in Table: 1

1.Cement	= 8.25 x1/5.95
2.Sand	=8.25 x1.5/5.95
3.Aggregate	=8.25 x3/5.95
4.Water	=8.25 x0.45/5.95

TABLE: 1 Material required as per is method of design

III. FLEXURAL STRENGTH FOR RCC BEAM

All beams (100mm x 150mm in cross section and 1600mm in length) were tested as simply supported beams under three point loading over an effective span of 1400mm. The load shall be applied at a rate of loading of 400kg/min for the 15 cm specimens and at a rate of 180kg/min for the 10cm specimens. The loads were applied at a distance of 533mm on either side of the mid span of the beams of 1600mm length. The loads were monitored through a high accuracy load cell with a load sensitive of 0.1 tonnes. For this case, mid span deflection was measured using dial gauges of least count 0.01mm. The parameters such as initial cracking load, ultimate load and the deflected shape of the specimens were noted.

Determine the modulus of rupture (F_b) = $3Pl / 2bd^2$ Where

p = maximum load

L = length of the specimen in mm b = breath of the specimen

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 5, May 2018

d = depth of the specimen.

SLUMP TEST

Slump is a measurement of concrete’s workability, or fluidity. A slump test is a method used to determine the consistency of concrete. The consistency, or stiffness, indicates how much water has been used in the mix. The concrete slump test is used for the measurement of a property of fresh concrete. The test is an empirical test that measures the workability of fresh concrete.

Trail	slump value in mm
1	55
2	58
3	52

TABLE 2: Slump Value

IV. EXPERIMENTAL RESULTS

FLEXURAL STRENGTH OF COMPOSITE BEAM:

The following table shows the details of the flexural strength of composite beams of different specimens of different thickness.

S.NO	SPECIMENS	LOAD (kN)	FLEXURAL STRENGTH(N/mm ²)
1	CONTROL BEAM 12mm	72	44.80
2	GLASS FIBER REINFORCED POLYMER REBARS	76	47.29
3	GLASS FIBER REINFORCED POLYMER REBARS	73	44.91
4	GLASS FIBER REINFORCED POLYMER REBARS	80	50.32

TABLE 3: flexural strength of composite beam

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 5, May 2018



(a)

(b)

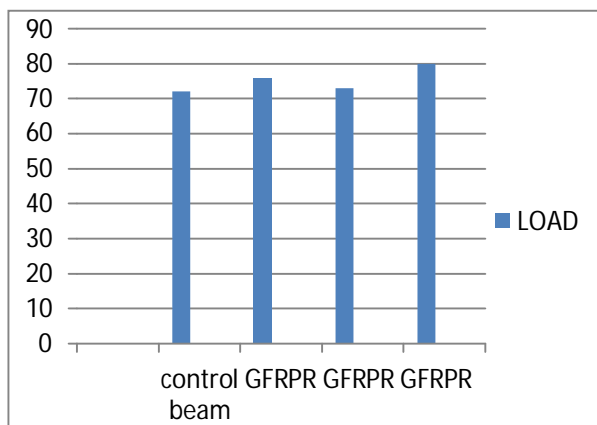
Fig. 1. Preparation of specimen (a) reinforcement steel (b) GFRP



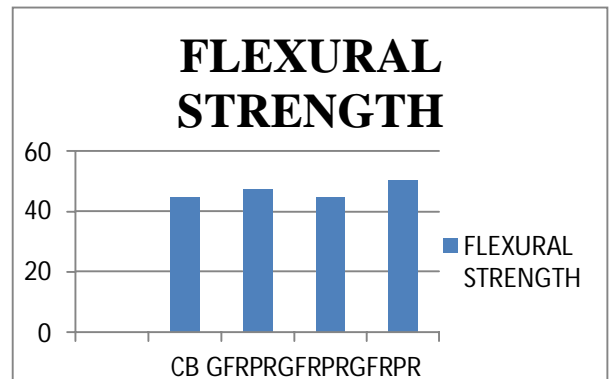
(c)

(d)

Fig. 2 Testing of specimen (a) flexural strength (b) initial crack formation



Load comparison for 12mm bars



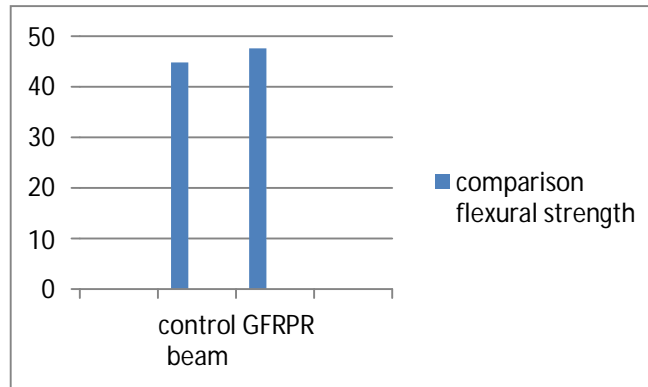
flexural strength

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 5, May 2018



Comparison flexural strength

V. CONCLUSION

From the project phase II following conclusions were obtained Flexural strength of concrete specimens. Then the Flexural strength of the cured specimens will be determined at 28days. And the results to be following,

- Flexural strength of the concrete beam = 44.80 N/ mm² (at 28 days) for M20 grade ofConcrete.
- Flexural strength of the GFRPR beam = 47.29 N/mm² (at 28 days) for M20 grade ofConcrete.
- Flexural strength of the GFRPR beam = 44.91 N/ mm² (at 28 days) for M20 grade ofConcrete.
- Flexural strength of the GFRPR beam = 50.32 N/mm² (at 28 days) for M20 grade ofConcrete.
- Mean vale ofGFRPRbeam = 47.50N/mm²

1. Experiments were carried out for hollow pipes such as GFRPR and GFRPR mean value compared with normal rebar beams in order to know the behavior and bending load of beam and tests were conducted under Monotonicloading.

2. Major conclusion from this study are: Load carrying capacity of beam with hollow GFRPR are economical for constructiontechniques.

3. .Fromthegivenreportitwasfoundthatamongthe comparison of mean value of hollow GFRPR has given maximum best flexural result. And thus their load carrying capacity is maximum than otherspecimens

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 5, May 2018

REFERENCES

- 1). Fiber Reinforced Polymer Reinforcing Bars in Concrete Structures, Nandini Devi, International Journal of Innovative Research in Science, Engineering and Technology Vol. 4, Issue 6, June 2015.
- 2) "Evaluation for Tensile Performance of Recently Developed FRP Hybrid Bars", Dong-Woo Seo, Ki-Tae Park, Young-Jun You, Ji-Hyun Hwang, International Journal of Emerging Technology and Advanced Engineering, Volume 4, Issue 6, June 2014, pp:631-637.
- 3) "FRP-Reinforced Concrete Beams Under Combined Torsion and Flexure", Esam El-Awady, Mohamed Husain, Sayed Mandour, International Journal of Engineering Science and Innovative Technology (IJESIT), Vol.2, Issue.1, January 2013, pp:384-393.
- 4) "Behavior Of Concrete Columns Reinforced With Longitudinal Fiber Reinforced Plastic Bars", Fakhreddin Danesh and Baharak Baradaran, Proceedings of International Conference on FRP Composites in Civil Engineering, CICE 2012, Rome, Italy, 13-15 June 2012.
- 5) Behaviour of reinforced concrete short columns with Fiber Reinforced polymers bars", Ehab M. Lotfy, International Journal Of Civil And Structural Engineering, Vol.1, No 3, 2010, pp:545-557.
- 6) Strength and serviceability performance of beams reinforced with GFRP bars in flexure", Biswarup Saikia, Phanindra Kumar, Job Thomas, K.S. Nanjunda Rao, Ananth Ramaswamy, Construction and Building Materials, Vol. 21, 2007, pp:1709-1719.
- 6) "Strength and serviceability performance of beams reinforced with GFRP bars in flexure", Biswarup Saikia, Phanindra Kumar, Job Thomas, K.S. Nanjunda Rao, Ananth Ramaswamy, Construction and Building Materials, Vol. 21, 2007, pp:1709-1719.
- 7) "Durability issues of FRP rebars in reinforced concrete members Cement & Concrete Composites, Francesca Ceroni, Edoardo Cosenza, Manfredi Gaetano, Marisa Pecce Vol. 28 (2006), pp:857-868.
- 8) Flexural and shear capacities of concrete beams reinforced with GFRP bars", A.F. Ashour, Construction and Building Materials, Vol. 20, 2006, pp:1005-1015.
- 9) Construction and cost analysis of an FRP reinforced concrete bridge deck", Adam C. Berg, Lawrence C. Bank, Michael G. Oliva, Jeffrey S. Russell, Construction and Building Materials, Vol. 20 (2006), pp:515-526.
- 10) Flexural Behaviour Of Sand Coated Glass-Fibre reinforced Polymer (GFRP) Bars In Concrete" Balendran R.V., Tang W.E., Leung H.Y. and Nadeem Proceedings of 29th Conference on Our World In Concrete & Structures: 25 - 26 August 2004, Singapore, pp:203-212